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THE PRODUCTION OF BIOETHANOL FROM CUSTARD APPLE PEELS (*ANNONA SQUAMOSA*) USING *SACCHAROMYCES CEREVISIAE*

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ABSTRACT

Bioethanol can be produced through fermentation process from the renewable sources for fuel and fuel additives. There is an increase in the need of bioethanol; hence the bioethanol must be produced using cheap and eco-friendly raw materials. According to these characteristics, fruit wastes can be considered as cheap and cost effective. In this study, the peels of the Annona squamosa (custard apple) were used as a raw material for the production of bioethanol using Saccharomyces cerevisiae and the results were compared using different parameters like time, temperature, pH and amount of yeast. The results of this work show that the rate of ethanol production through the fermentation of custard apple wastes yields are very high at pH 6, temperature 40°C, 7th day, and 10g of yeast and the yield obtained from the optimized parameters is 22.8% (v/v). The results of this present study proposed that the wastes from the fruits that comprises fermentable sugar should not be cast-off on our environment, rather it should be converted into a useful product like bioethanol that can assist as an another energy source.

***KEYWORDS:** Bioethanol, Annonasqumosa, Saccharomyces Cerevisiae & Fermentation*

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Original Article

INTRODUCTION

Generally, Ethanol is used as a fuel additive and a motor fuel. In industries, it is used as a significant component and it used as a base chemical, an antibacterial hand sanitizer gels and as an antiseptic and also used in medical wipes (Janani et al., 2013). Approximately 80% is the supply of alcohol that has been produced by the fermentation of sugar and starch (Sandhesh et al., 2014). Ethanol provides energy that is renewable. For a proficient ethanol production, four constituents should be required (i.e., fermentable sugars, yeast strain, nutrients and the culture conditions). By using an agricultural feedstock, bioethanol a type of renewable energy source is produced. The first generation of production of ethanol consumed corn as a substrate and later it is well thought out as a feedstock which hints to the second generation of ethanol production which makes use of microorganisms and different wastes as substrates.

On everyday base, heaps of agro-bio wastes are generated, but it is of no use. If we enhance some amount of value to these waste products, we get necessary value added products. After the fermentation process, the waste materials can be utilized as a soil fertilizer (Ishwar et al., 2013). Fruit wastes have good antibacterial and antioxidant properties. The cheapest and the easily accessible raw material for the production of bioethanol are fruit wastes. It is the latent basis from which the ethanol can be produced. The present study was carried out to investigate the production of bioethanol by Saccharomyces cerevisiae utilizing custard apple peels and to optimize the ethanol using different parameters such as pH, time, temperature, amount of yeast.

MATERIALS AND METHODS

Preparation of Custard Apple Peels

Custard apple peels were washed with distilled water and are cut into small pieces and kept in a sunlight for few days, then kept in oven under 55°C for drying (Shilpa et al., 2013).

Preparation of Substrate

After drying, a sample was taken in a pestle and mortar, grinded well and made into powdered form. The powder stored for the further process to be carried out for the project (Subhash et al., 2016).

Fermentation Process

About 50g of the sample weighed separately and 5g of yeast added into it to carry out the fermentation process (Janani et al., 2013). The sample was then kept for incubation in an incubator shaker at 30°C, 100rpm and pH 7. The fermentation system optimized using various parameters like time, temperature, pH, the concentration of the inoculum (Saravana et al., 2013, Irfan et al., 2014, Abebe et al., 2015).

Extraction of Ethanol by Distillation

Distillation unit at boiling point at 78°C used to separate the mixture of ethanol and other residues. For distillation, batch distillation was adopted.

Alcohol Content Estimation

The distilled product sample will be undergoing potassium dichromate method for the estimation of ethanol (Girish et al., 2014).

Optimization of Bioethanol

The optimization was done using different parameters such as pH, time, temperature, the amount of the substrate and yeast. The samples will be established in a varying pH values (pH=4.5-6.5) and varying temperature (25°C-45°C) and varying concentration of yeast (2.5g-12.5g) in order to find out the effect of pH, time, temperature, the amount of substrate and yeast in the ethanol production (Sandhesh et al., 2014, Irfan et al., 2014, Adriana et al., 2015).

RESULTS AND DISCUSSIONS

In this study, it has been investigated that a significant amount of ethanol can be produced from the wastes of the custard apple. The relative study has been done to check the efficiency of ethanol produced from the fruit waste by deciding different parameters. The impact of different parameters on the production of ethanol is presented as follows:

Effect of Time on Ethanol Production

From 0^{th} day to 12^{th} day at regular intrevals of 24 hours, the alcohol content was estimated using potassium dichromate method and it was observed that the alcohol content increases from day 1 and it further increases day by day. The maximum alcohol content was produced in the 7^{th} day. After 7^{th} day the alcohol content decreases gradually. It was found that the ethanol was produced at the maximum on day 7. The percentage of ethanol obtained on the 7^{th} day is **19.24%** (From graph).

Effect of pH, Temperature, Amount of Yeast on Ethanol Production

pH value has an important effect on the alcoholic fermentation. The pH values of ethanol produced by the process of fermentation ranges from 4.5-6.5. Yeasts survive in a slightly acidic environment. Among this range ethanol produced from custard apple fruit wastes had on higher alcoholic content at pH 6. The maximum alcohol percent obtained at the pH 6 is **11.2%** (v/v).

Temperature plays an important role in the production of ethanol, since the alcoholic fermentation increases with the increase in the temperature. The optimum temperature of ethanol ranges from 25°C-45°C which depends on room temperature. The highest yield obtained at 40°C is **12.25%** (v/v).

For the yeast concentration the rates increased rapidly with the increase in the amount of yeast added, up to the yeast concentration of 10g/100g of substrate and the optimum yield was obtained up to **20.8%** (v/v).

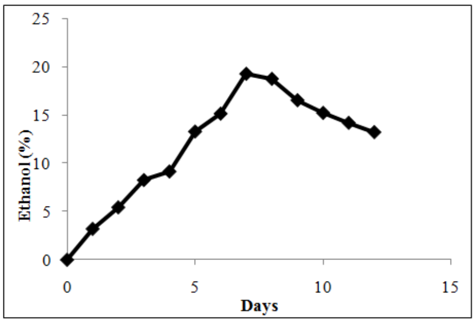

Figure 1: Effect of Time

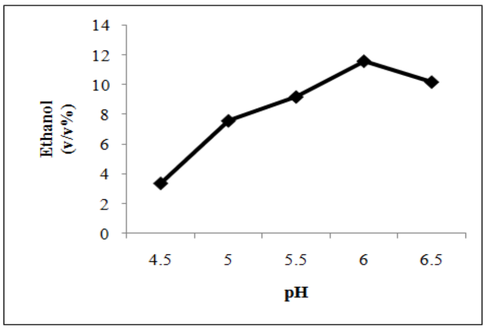

Figure 2: Effect of pH

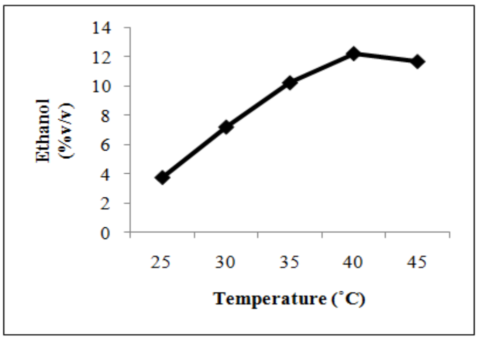

Figure 3: Effect of Temperature

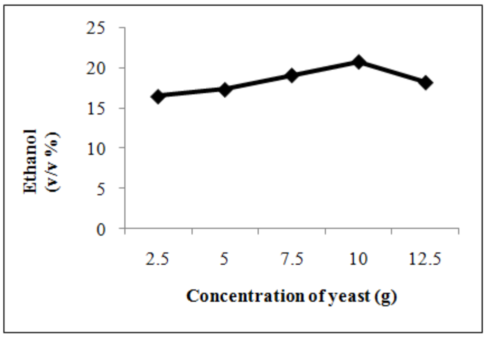

Figure 4: Effect of Concentration

CONCLUSIONS

In my present study, ethanol obtained from the custard apple peels using yeast species *Saccharomyces cerevisiae*. The results conclude that a more concentrated form of ethanol might be attained by re-distillating the product ethanol obtained initially by a developed grade of distillation set up. The more concentrated form of ethanol possibly well used as a biofuel, which discharges no poisonous gases out in the environment. This method is easy approachable to the environment and the leftward residues after the fermentation process can be disposed in the soil acting as a fertilizer for the soil. So even a common man may develop this process and produce it on a commercial basis.

The fermentation of substrate using *S.cerevisiae* (distillery strain) under optimized conditions i.e. pH 6and temperature 40ºC revealed an increase in ethanol production with good fermentation efficiency. However fermentation

efficiency deceases after 7th day of fermentation time. This might be due the either substrate limitations or due to product inhibition. *S. cerevisiae* reportedly showed the decrease in growth with an increase in ethanol concentration in the medium.

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